

IV.—*On the Occurrence of Lusitanian Brachiopods in the Persian Gulf.* By J. WILFRID JACKSON, F.G.S. (Manchester Museum).

SOME months ago I received from Dr. J. Cosmo Melvill a small box containing brachiopods from the Persian Gulf. These had been obtained by Mr. F. W. Townsend in the course of his dredgings for Mollusca in that region. The locality on the box containing the specimens is Dabai, which lies within the Persian Gulf on the N.W. coast of Oman. Its exact position is on the west side of the peninsula of Ruus El Jibál, on what is known as the Pirate Coast. Unfortunately, no particulars as to depth etc. accompanied the specimens.

With the exception of the Mollusca and some Madreporarian corals very little appears to be known of the fauna of the Persian Gulf. The Mollusca have been ably dealt with in a series of papers by Messrs. Melvill and Standen*, and the corals were described in 1911 in a paper by Miss Ruth Harrison †, to which Professor S. J. Hickson added some further notes ‡.

The discovery of Brachiopoda in the Persian Gulf is of very great interest, not only from the fact that these specimens are the first of the class to be recorded from this region—*i. e.*, the N.W. corner of the Indian Ocean (including the Persian Gulf, Gulf of Oman, and Arabian Sea),—but more especially from the important bearing of these specimens on the subject of the relation of the fauna of the Persian Gulf to that of the Mediterranean Sea and Atlantic Ocean.

Four specimens only were present in the box, one of which is a *Terebratulina*, the other three belonging to the genus *Mühlfeldtia*. All are dead empty shells, and a small quantity of greyish marl was present in the interior of one or two. Unfortunately, in the case of the *Terebratulina*, the brachidium, or loop, is broken, but the shell is otherwise quite perfect, both valves being present. In form and size it is very like a specimen of *Terebratulina caput-serpentis* figured by Fischer and Oehlert from the 'Talisman' Expedition in the Lusitanian Subregion §. It has the same general outline and is cut off

* For list of papers see Proc. Zool. Soc. 1906, p. 783.

† Proc. Zool. Soc. 1911, pp. 1018-1037.

‡ *Id.* 1911, pp. 1037-1042.

§ Fischer and Oehlert, "Expéditions Scientifiques du 'Travailleur' et du 'Talisman' etc.," Brachiopodes, 1891, pl. ii. fig. 4, v.

(truncated) anteriorly. The size of the specimen is:—Length 15·7, breadth 13·5, thickness 7·4 mm. It is much depressed dorso-ventrally and exhibits incipient uniplication, possessing a broad but low dorsal fold and a very shallow sulcus down the ventral valve. It presents some slight resemblance to examples of *T. caput-serpentis* from the Mediterranean named var. *emarginata*, Risso (= *mediterranea*, Jeffreys*), but is not notched anteriorly as in that form. The test is thicker than in recent specimens of *emarginata*; the shell-surface is also more strongly striated, and possesses stronger and more numerous growth-lines. The striæ are somewhat nodulose, especially posteriorly; the lateral primaries diverge rather sharply near the umbo of the dorsal valve—a noticeable feature. The specimen differs from dredged examples of *T. caput-serpentis* from Oban, W. of Scotland, Trondhjem, Norway, and other North-Atlantic places by its flatness, by the early divergence of the primary striæ, and by the striæ in general not presenting the same fasciculate aspect. In this respect the specimen agrees better with the Mediterranean form.

In 1908 Blochmann † created a new species—*Terebratulina valdiviæ*—for some specimens collected by the 'Valdivia' Expedition in the Indian Ocean, off the S. coast of Nias, at 677 metres (=376 fath.). These specimens were originally considered and labelled as *T. caput-serpentis*, but a later study of the spiculation of the animal furnished good evidence, together with a characteristic difference in the construction of the brachidium, that a new species was represented. Blochmann, unfortunately, gives no figure of the shell, and his description is on the whole very meagre. He merely states that it agrees in general appearance with the Mediterranean form of *T. caput-serpentis*, but is a little flatter and wider. The absence of the animal and the imperfect condition of the brachidium in the Dabai specimen are to be regretted, as a comparison with *T. valdiviæ*, based on these characters, is not possible. Blochmann, in comparing the spiculation of *T. valdiviæ* with *T. caput-serpentis*, unfortunately made use of Norwegian examples of the latter instead of Mediterranean specimens, so that the precise relationship between the Mediterranean and Indian-Ocean forms is somewhat uncertain.

There is some probability that *T. valdiviæ*, the Dabai form,

* Davidson, "Monograph of Recent Brachiopoda," Pt. I., Trans. Linn. Soc. Lond. 2nd ser. vol. iv., Zool. 1886 (p. 25 reprint), pl. v. figs. 35-37.

† Blochmann, "Zur Systematik und geographischen Verbreitung der Brachiopoden," Zeit. für wiss. Zoologie, Bd. xc. 1908, pp. 606-607 (spicula figured, pl. xxxvi. figs. 5, 6).

and the Mediterranean var. *emarginata* are closely related. The latter is very distinct in shell-characters from the typical North-Atlantic *T. caput-serpentis*, and merits its distinctive name. The same may be said of the Dabai form, and for the purpose of easy reference it might be known as var. *abbreviata*, nov.

T. caput-serpentis is widely distributed along the eastern side of the Atlantic Ocean, being recorded from off the coasts of Norway, British Isles, France, Spain and Portugal, Canaries, and West Africa. It is represented at the Cape Verde Islands by a variety (var. *germana*)* intermediate between the type and *T. septentrionalis*.

In the Mediterranean it is recorded from many stations in the western portion, but appears to be altogether absent in a recent state in the eastern part.

According to Fischer and Oehlert (*op. cit.* p. 35) the species appears to have a very extended fossil distribution, ranging from Miocene to recent times. The principal localities are in the Mediterranean region: N. Italy (Lower Miocene and later), S. Italy and Sicily (Lower Pliocene and later), Provence (Pliocene), and Algiers (Pliocene). It has also been cited by authors for the Miocene of Morea, Sicily, Switzerland, and the Azores. Ancestral forms are known from the Eocene (often given as vars. of *T. caput-serpentis*, especially in N. Italy †), and from the Cretaceous.

Of the three specimens of *Mühlfeldtia* from Dabai one agrees very closely with examples of *M. truncata* from Mediterranean localities. Compared with specimens from Messina (Sicily) and Sardinia, no distinct points of difference can be noted, either in outward appearance or in the development of the loop. This specimen measures:—Length 12·7 mm., breadth 15·8, thickness 6·8 mm.

The two remaining examples differ somewhat from typical *M. truncata* in certain characters. Though these differences may be only of varietal rank, it might be advisable to give a full description of the form in question to enable it to be traced in other collections. In order to distinguish it, I propose to call it var. *paucistriata*, nov.

The more perfect of the two specimens is somewhat smaller than average *M. truncata*, being length 9·2 mm., breadth 11·6, thickness 4·4, and may be described as

* Fischer and Oehlert, *op. cit.* 1891, p. 33, pl. i. fig. 4, a-f.

† Sacco, 'I Brachiopodi dei Terreni Terziarii del Piemonte e della Liguria,' 1902, p. 26.

follows:—Shell transverse oval; valves unequal; ventral convex and deep, with subdued carination, dorsal flattened and shallow, with feeble median sinus on anterior two-thirds (*i. e.*, the shell is ventrally uniplicate). The exterior of the ventral valve is covered with sparse striæ which are somewhat incipiently aculeate, especially on the lateral parts of the valve. Some striæ disappear before reaching the anterior border in the middle part. On the lateral parts interpolated striæ appear towards the margin as discontinuous nodulose ribs. There is a distinct cardinal area, which is striated transversely. The interior of this valve is almost smooth in the umbonal part, becoming nodulose towards the margin. The nodules radiate from the posterior end. There is a short pedicle-collar joining up with the bases of the teeth, and a distinct median septum reaches almost to the middle of the valve. The latter extends under the pedicle-collar, but does not support it. On the exterior surface of the dorsal valve the striæ are less in number and of a different character. In the umbonal region they are thick and somewhat nodulose. Some of these reach the margin as thin striæ, others disappear entirely or die out for a time and then reappear near the margin. The striæ are not so noticeably aculeate as on the ventral valve. A slight but distinct area (transversely striated) is visible on each side of the median notch. The interior of the dorsal valve is strongly nodulose (or papillose), the nodules being arranged in rows radiating from the beak. The hinge-processes (cardinalia) consist of widely divergent dental sockets and socket-ridges (hollowed out underneath). There are no median hinge-plates, and the crura arise from the anterior corners of short plates attached to the undersides of the dental socket brackets. In the umbonal portion (between the brackets) is a callous deposit on the floor of the valve, from which extends a stout median septum which reaches almost halfway down the valve. The brachidium or loop is unfortunately slightly imperfect, but is essentially as in typical *M. truncata*, with lateral lacunæ, as in the latter.

All the specimens of *M. truncata* which I have seen from Mediterranean localities (both recent and fossil) have numerous thin striæ on the surface of both valves, the striæ at times being distinctly nodulose; but among a small number of specimens from Tenerife, Canaries (70 fath.), there is one which shows an approach to the above-named var. *paucistriata*.

With the exception of the sparse and peculiar striation, the characters detailed above are seen generally in typical

M. truncata, though some, such as the double cardinal area (*i. e.*, a dorsal as well as a ventral area), do not appear to have been emphasized hitherto*. Thomson† has recently called attention to the fact that in *Mühlfeldtia* the foramen is shared by both valves, the greater portion being in the ventral valve. For this position of the foramen he applied the term Amphithyrid, which has since been altered to Symbolothyrid as being more accurate‡.

M. truncata is widely distributed in the Mediterranean from Gibraltar to the Ægean and on the Atlantic coast from the English Channel to the Canaries. It is also recorded as a fossil in the Mediterranean region:—Morea (Miocene?), Malta (Miocene), S. Italy and Sicily (Lower Pliocene and later), N. Italy (Lower Pliocene), Provence (Pliocene), and Sardinia (Pliocene). Fischer and Oehlert (*op. cit.* p. 91) cite from the Lower Pliocene of Sicily and Calabria (ex Seguenza) a var. *granulata*, which they believe may be more nearly related to the recent *M. echinata*, only known at present from off Cape Bojador, West Africa. The var. *serravallensis*, Sacco §, from the Middle Miocene of N. Italy, may be also referable to the same. *M. truncata* has been recorded from the Miocene of the Vienna Basin and of North Italy, but the form in question is now regarded as distinct and appertaining to *M. oblita*, Michelotti, probably a smooth ancestral species||.

The most interesting record for *M. truncata* outside the Mediterranean—East Atlantic region is that of Deshayes ¶ for the Island of Réunion. A single example was found here on a crustacean dredged at 200 fath., and was described under the name of *Morrisia gigantea* by Deshayes. Judging from illustrations it is obviously a small form of *M. truncata* **, differing only in the scanty nature of the striæ. In this respect it closely resembles the Persian Gulf variety described

* This double cardinal area is present in *Megathyris decollata*; a distinct ventral area and a slight dorsal one are present also in *Kraussina rubra*.

† Thomson, 'Brachiopoda Australian Antarctic Expedition, 1911-14,' Scientific Reports, ser. C, vol. iv. pt. 3, 1918, p. 20.

‡ Trans. New Zealand Institute, vol. li. 1919, p. 452 (footnote).

§ Sacco, *op. cit.* p. 28, pl. v. figs. 52, 53.

|| Fischer and Oehlert, *op. cit.* pp. 85-86.

¶ Deshayes, Cat. des Moll. de l'île de la Réunion (Bourbon), 1863, p. 37 (reprint), pl. v. figs. 9, 10, 11.

** Fischer and Oehlert (*op. cit.* p. 84) have evidently taken Deshayes' enlarged figures (pl. v. figs. 9, 10) as representing the natural size, having overlooked the dimensions given in the text.

above. Its occurrence in this region has been remarked upon by several writers, including Davidson *, who regarded the locality as at fault. The present discovery of *Mühlfeldtia* in the Persian Gulf adds further proof of the occurrence of the genus outside the region to which it has hitherto been supposed to be restricted.

The occurrence of two typical Lusitanian species of Brachiopods in the Persian Gulf is of great interest from the point of view of geographical distribution. As pointed out by Schuchert †, "the present Mediterranean is the remainder of the ancient and far more extensive Tethys, always more or less in connection with the North Atlantic (= Poseidon), and in early Tertiary time communicating freely with the Indian Ocean." A survey of the present distribution of certain groups of animals brings out very clearly that several forms have spread through this ancient Tethys. The Brachiopods are particularly interesting from this point of view. In addition to the two forms dealt with in this paper, others have been recorded from time to time, all of them pointing to an intimate connection between the Atlantic and Indian Oceans by way of the Mediterranean. In some cases the same species is common to both oceans; in others, species of the Indian Ocean are closely allied to Atlantic forms. One of the most characteristic forms is the large *Dyscolia wyvillei* (Dav.), common on the east coast of the Atlantic from the Bay of Biscay to the Cape Verde Islands. It also occurs as a relict in the Antilles region. The same form is known from the Maldives, through the researches of Alcock, who described and figured the species under the name of *Terebratula johannis-davisi* ‡. The Indian Ocean form has been carefully studied by Joubin § and Blochmann ||, and both consider it to be identical with the Atlantic species. In all probability it originated in ancient Tethys, as an ancestral form, *Dyscolia* (olim *Terebratula*) *quiscardiana* (Seg.), is found in the Pliocene of Sicily ¶. *Chlidonophora* is another genus having representatives in the Indian and Atlantic Oceans, and nowhere else. *C. incerta* (Dav.) is found off

* Davidson, *op. cit.* pt. ii. 1887, p. 105.

† Schuchert, "Paleogeographic and Geologic Significance of Recent Brachiopoda," *Bull. Geol. Soc. America*, vol. xxiii. 1911, p. 271.

‡ Alcock, 'Journal Asiatic Society of Bengal,' vol. lxiii. pt. ii. 1894, pp. 139-140.

§ Joubin, *Bull. de l'Inst. Océan. Monaco*, no. 103, 1907, p. 6.

|| Blochmann, *op. cit.* 1908, p. 638.

¶ Fischer and Oehlert, *op. cit.* 1891, p. 29.

Havana and in the equatorial mid-Atlantic, while a very closely allied form—*C. chuni*, Bl.—occurs in the Indian Ocean off the Maldives. The occurrence of *Kingena alcocki*, Joubin*, in the Indian Ocean is also significant, as, if well established, it can be correlated with the Cretaceous occurrence of the genus in Europe.

The following occurrences of certain Brachiopods in the Indian Ocean may also be mentioned, but more information is desired regarding their relationships. *Lacazella mediterranea* (Risso), a western Mediterranean species, occurring also off Jamaica and in the Gulf of Mexico, and as a fossil in the Miocene and Pliocene of Italy, is stated by Sir H. Barkly to occur off Mauritius; but this statement must be taken with reserve according to Davidson †. *Liothyrina cernica* (Crosse) was found in the stomach of a fish taken at 80 fath. deep off Mauritius. It is reported to approach the Mediterranean *L. vitrea* (Born) and, even more closely, *L. cubensis* (Pourtales), the West Atlantic form of the Lusitanian *L. sphenoidea* (Phil.) ‡. According to Blochmann §, Studer mentions a *Liothyrina* from Mauritius which may belong to the same species. Further, a *Liothyrina*, sp. indet., is recorded by Dall || from south of Saya de Malha Banks, N.N.E. of Mauritius. In outward form it approaches *L. bartletti*, Dall, from the Antilles region; its loop shows affinity with *L. sphenoidea* (Phil.), and the spiculæ are closely allied to *L. vitrea* (Born).

The relationship between the fauna of the Indian and Atlantic Oceans, as exhibited by the Brachiopoda, is also shown clearly by other groups of marine animals. A few points only can be referred to here.

Doderlein ¶ considers a number of the common sea-urchins of both faunal regions to be so nearly allied as to be better regarded as varieties only of one and the same species, rather than specifically distinct.

Doflein ** remarks on the close affinity of the Brachyura of

* Joubin, Bull. Mus. d'Hist. Nat. Paris (1906), 1907, pp. 529-532. (This has the appearance of a young form of *Laqueus*.—J. W. J.)

† Davidson, *op. cit.* pt. ii. p. 158.

‡ Crosse, 'Journal de Conchyliologie,' vol. xxi. p. 285, and vol. xxii. p. 75, pl. i. fig. 3 (1873); see also Davidson, *op. cit.* pt. i. 1886, p. 16, pl. i. fig. 19.

§ Blochmann, *op. cit.* 1908, p. 625.

|| Dall, Trans. Linn. Soc. Lond. 2nd ser., Zool. vol. xiii. pt. 3, 1910, p. 439, pl. xxvi. figs. 1-2.

¶ *Fide* Blochmann, *op. cit.* 1908, p. 637.

** *Id. ibid.*

both regions. He more especially compares the species on the East-African coast, and regards them as identical with species found in the Atlantic.

Alcock* points out that the sublittoral (25–250 fath.) genera and species of Paguridæ inhabiting the Indian seas appear to be most closely related to the sublittoral hermits of the West Indies and of the north-west coast of Africa and its outlying islands.

As pointed out by Prof. S. J. Hickson †, Alcock, in his comments on the deep-sea Madreporaria of the Indian Ocean, calls attention to the “many intimate affinities of the fauna of moderate depths of the Indian seas with the North-Atlantic fauna,”* and considers them “to be sufficient to suggest a direct sea-connection, in the past, between the Atlantic and Indian Oceans, and the case of *Caryophyllia communis* and *Flabellum laciniatum* would indicate that the connection was by way of the Mediterranean.” Among the species of Madreporarian corals obtained by Townsend in the Persian Gulf, and described by Miss R. Harrison and Professor S. J. Hickson †, is one, *Pyrophyllia inflata*, which appears to provide even stronger evidence of the truth of Alcock’s hypothesis, and to suggest a former connection of the Gulf with the Mediterranean Sea. *Pyrophyllia* is related to the recent *Gygnia annulata*, Duncan, from the Adventure Bank, in the Mediterranean (92 fath.), and to the extinct genus *Conosmia*, found in Tertiary deposits of Australia. Among the other corals found in the Persian Gulf is a species of *Trematotrochus* (*T. zelandice*), identical with a recent coral from Cook’s Strait, New Zealand, and closely related to species of the same genus from the Tertiary deposits of Australia, and to a recent form found in St. Vincent Gulf and Backstairs Passage, S. Australia, at depths of from 15 to 22 fathoms. The above facts are significant in connection with the close relationship which seems to exist between certain of the Brachiopod genera of Australia–New Zealand on the one hand, and Atlantic–Mediterranean on the other. This point has recently been emphasized by Thomson §, and want of space precludes a discussion here; but it may be of interest to mention that the Brachiopod genera concerned are

* Alcock, “Paguridæ” in ‘The Fauna and Geography of the Maldivæ and Laccadive Archipelagos,’ ed. by J. Stanley Gardiner, vol. ii. 1903–1906, p. 828.

† Hickson, *op. cit.* 1911, p. 1038.

‡ *Id. ibid.* pp. 1020, 1038–1039.

§ Thomson, *op. cit.* 1918, p. 57.

Cryptopora and *Argyrotheca*, which are recorded from the Australian and Atlantic-Mediterranean regions (the last-named is also fossil in New Zealand), and *Amphithyris*, which is recorded from the New Zealand and Mediterranean regions.

Doubtless a close study of other groups of animals would reveal similar analogies.

In conclusion, I might point out that Melvill and Standen*, in their paper on "The Mollusca of the Persian Gulf etc.," remark that the Persian Gulf fauna bears a considerable generic analogy with the Mediterranean molluscan fauna, though so widely differing specifically.

Supplementary Notes on the foregoing Paper.

While the above paper was in the hands of the printer, I received from Dr. W. H. Dall a memoir dealing with the collection of Recent Brachiopoda in the United States National Museum †. In this report Dr. Dall has had occasion to revise the nomenclature of certain of the forms dealt with in the foregoing pages. The chief alterations are as follows:—*Terebratulina caput-serpentis* (Linné, 1767) should be *T. retusa* (Linné, 1758); *Mühlfeldtia truncata* (Linné, 1767) becomes *M. discutus* (Pallas, 1766), though in this I cannot readily concur, as Pallas' figures are very unlike the species in question; the *Lacazella mediterranea* (Risso) from Mauritius (*Sir H. Barkly*) is regarded as a distinct species under the name *L. mauritiana*, Dall; *Kingena alcocki*, Joubin, is placed in the genus *Frenulina*, which, from a recent study of a specimen in the British Museum, I can corroborate: the loop, if anything, is very slightly more advanced than that of the genotype *Frenulina sanguinolenta* (Gmelin); it possesses, however, the same type of cardinalia, also dental plates and a fused pedicle-collar in the ventral valve. Dall's specimen is from the Sulu Sea ('Valdivia' Exped.), that belonging to the British Museum is labelled "Off Travancore, Dr. Blochmann." *Terebratulina valdivia*, Blochmann, is recorded by Dall (*op. cit.* p. 301) from numerous localities (other than the type-station, off Nias, Sumatra), including Korea, Philippine Islands, and China Sea. With regard to the *Morrisia gigantea*, Deshayes (Isle of Réunion), Dall places this tentatively in *Pantellaria* (olim *Mühlfeldtia*) *echinata* (F. & O.), which he also records from the Cape of Good Hope, New South Wales, Barbados, and Sand Key, Florida. From

* Melvill and Standen, *op. cit.* 1906, p. 783.

† Proc. U.S. Nat. Mus. vol. lvii. 1920, pp. 261-377.

Deshayes' description and figures I am not convinced of the identity of "*gigantea*" with the *Mühlfeldtia echinata*, F. & O., but am more inclined to refer it to *M. truncata*, var. *paucistriata*. The presence of *Mühlfeldtia* at the Cape and Australia is remarkable, and of great importance from the point of view of distribution. I am able to record the presence of an immature example of *M. truncata*, labelled "S. Africa. J. H. Ponsonby coll., 1900. 6. 13. 4." in the British Museum. This point, and the occurrence at the Cape of other new species with Mediterranean affinities, will be discussed in a future memoir on the Brachiopoda in the Cape Town Museum.

In the foregoing pages I omitted to call attention to Dr. J. H. Ashworth's discovery of larval forms of *Lingula anatina* in the Red Sea*. In June 1914 this author obtained fourteen larvæ of the above in the southern part of the Red Sea, lat. 15° N., long. 42° E.; and in October of the same year two larvæ were again taken in the same neighbourhood; one larva in the Indian Ocean, about 4° south of Colombo; and six larvæ of *Pelagoliscus atlanticus* (King) a little to the south of Cape Comorin, S. India.

While examining the Brachiopoda at the British Museum recently I discovered a specimen (in spirit) labelled "*Lingula anatina*. Durban. J. H. Ponsonby. 99. 4. 14. 1." This requires further study.

According to Dall (*op. cit.* pp. 262-263) *Lingula anatina* should be known as *L. unguis* (Linné, 1758).

The following are to be added to the fauna of the Arabian Sea:—*Lingula translucida*, Dall, 1920, Karachi; also found at Java and the Philippine Islands (Dall, *op. cit.* p. 264); *Lingula hians*, Swainson, Bombay (Melville and Abernethy) †.

This is not the place to discuss Dr. Dall's useful List of Recent Brachiopoda, but a good opportunity is provided to call attention to the fact that Dall's new subgenus *Pereudesia* (p. 360) is antedated by my *Coptothyris* (Oct. 1918) ‡. It is unfortunate that Dr. Dall has anticipated many of my own conclusions, which were arrived at during researches dating from before the war, various duties during the interval having prevented me from writing them up for publication.

* Trans. Roy. Soc. Edinb. vol. li. pt. i. 1915, pp. 45-69, pls. iv. and v.

† Mem. and Proc. Manch. Lit. & Phil. Soc. 4th ser. vol. vii. 1893, p. 35.

‡ J. W. Jackson, "On *Terebratula grayi*, Davidson," Geol. Mag., Oct. 1918, pp. 479-480.